

CLAIMS

1 **1.** An optical fiber, comprising:
2 a plurality of air holes around a core,
3 wherein said air holes in proximity of a connecting end
4 of said optical fiber are filled with a light transparent material
5 made of a resin or a glass or the like that has a refractive
6 index lower than that of a quartz-based material.

1 **2.** The optical fiber according to claim 1, wherein:
2 said optical fiber is a photonic crystal fiber that said
3 air holes are periodically arranged in a hexagonal lattice form
4 from a central portion of the optical fiber, where a crystal
5 defect exists.

1 **3.** The optical fiber according to claim 1, wherein:
2 said optical fiber is a Holey fiber that comprises, in
3 said core or a cladding thereof, said plurality of air holes
4 extending in an axial direction of the Holey fiber.

1 **4.** The optical fiber according to claim 1, wherein:
2 the resin filled in said air holes is a UV-curable resin.

1 **5.** An optical fiber connection method, comprising:
2 by using a V-groove splicer or the like, connecting
3 end-to-end said optical fiber as defined in claim 1 to an optical
4 fiber that has a mode field diameter larger than that of said
5 optical fiber as defined in claim 1 on a V-groove of said V-groove
6 splicer.

1 **6.** An optical fiber connector, comprising:
2 a ferrule on which said optical fiber as defined in claim
3 **1** is mounted, said optical fiber being ground at an end face
4 thereof.

1 **7.** A sealing structure of an end portion of an optical
2 fiber, comprising:
3 a high refractive index core; and
4 a low refractive index cladding formed around said core,
5 said cladding comprising a plurality of air holes extending in
6 an axial direction of said optical fiber,
7 wherein said air holes are sealed by a sealing portion
8 made of glass in said end portion, and
9 said cladding comprises a portion in which said sealing
10 portion is formed and which is provided with a diameter that
11 is the same as that of a portion in which said sealing portion
12 is not formed.

1 **8.** The sealing structure of the end portion of the optical
2 fiber according to claim **7**, wherein:
3 the sealing portion comprises glass that has the same
4 composition as glass composing said optical fiber.

1 **9.** The sealing structure of the end portion of the optical
2 fiber according to claim **7**, wherein:
3 the sealing portion comprises glass that has a melting
4 point lower than glass composing the optical fiber.

1 **10.** The sealing structure of the end portion of the optical

2 fiber according to any one of claims 7 to 9, wherein:
3 the optical fiber is mounted and fixed to a connector
4 ferrule.

1 11. A method for sealing an end portion of an optical fiber,
2 comprising:
3 forming at said end portion of said optical fiber an end
4 face that is substantially at right angles to an axial direction
5 of said optical fiber in said end portion, wherein said optical
6 fiber comprises a high refractive index core and a low refractive
7 index cladding formed around said core, the cladding comprising
8 a plurality of air holes extending in the axial direction;
9 inserting a glass powder from said end face into said air
10 holes, said glass powder comprising the same composition as glass
11 composing said optical fiber; and
12 subsequently heating said end portion of said optical fiber
13 to fuse said glass powder and thereby seal said air holes.

1 12. A method for sealing an end portion of an optical fiber
2 comprising:
3 forming at said end portion of said optical fiber an end
4 face that is substantially at right angles to an axial direction
5 of said optical fiber in said end portion, wherein said optical
6 fiber comprises a high refractive index core and a low refractive
7 index cladding formed around said core, the cladding comprising
8 a plurality of air holes extending in the axial direction;
9 inserting a glass powder from said end face into said air
10 holes, said glass powder comprising a melting point lower than
11 glass composing said optical fiber; and

12 subsequently locally heating a proximity of an end portion
13 of said air holes to fuse said glass powder and thereby seal
14 said air holes.

1 **13.** A method for sealing an end portion of an optical fiber
2 comprising:
3 forming at said end portion of said optical fiber an end
4 face that is substantially at right angles to an axial direction
5 of said optical fiber in said end portion, wherein said optical
6 fiber comprises a high refractive index core and a low refractive
7 index cladding formed around said core, the cladding comprising
8 a plurality of air holes extending in the axial direction; and
9 subsequently locally heating a proximity of an end portion
10 of said air holes to fuse said glass powder and thereby seal
11 said air holes.

1 **14.** The method for sealing the end portion of the optical
2 fiber according to claim **12** or **13**, wherein:
3 said end portion of said air holes is locally heated and
4 fused by irradiating thereto carbon dioxide gas laser light to
5 seal said air holes.

1 **15.** The method for sealing the end portion of the optical
2 fiber according to any one of claims **12** to **14**, wherein:
3 said optical fiber is beforehand mounted on and fixed to
4 a connector ferrule.

1 **16.** An optical fiber, comprising:
2 a high refractive index core and a low refractive index

3 cladding formed around said core, the cladding comprising a
4 plurality of air holes extending in an axial direction of said
5 optical fiber; and

6 a sealing portion formed at an end portion of said plurality
7 of air holes,

8 wherein said sealing portion comprises a quartz-based fine
9 particle that has a refractive index equal to or lower than that
10 of said cladding, and an optical adhesive that has a refractive
11 index equal to or lower than that of said cladding.

1 **17.** The optical fiber according to claim **16**, wherein:
2 said quartz-based fine particle has a diameter of **1** μm
3 or less.

1 **18.** The optical fiber according to claim **17**, wherein:
2 said quartz-based fine particle is doped with an additive
3 that reduces the refractive index thereof.

1 **19.** The optical fiber according to claim **16**, wherein:
2 said optical adhesive is a UV-curable optical adhesive.

1 **20.** An optical fiber connector, comprising:
2 said optical fiber as defined in any one of claims **16** to
3 **19** mounted on a ferrule.

4
1 **21.** A connection portion of an optical fiber, comprising:
2 said optical fiber connected to another optical fiber,
3 said optical fiber comprising a plurality of air holes in a
4 cladding formed around a core of said optical fiber,

5 wherein said optical fiber is joined end-to-end to said
6 another optical fiber through a refractive index matching agent
7 that has a refractive index at a minimum temperature in practical
8 use lower than that of said core.

1 **22.** A connection portion of an optical fiber, comprising:
2 said optical fiber connected to another optical fiber,
3 said optical fiber comprising a plurality of air holes in a
4 cladding formed around a core of said optical fiber,
5 wherein said optical fiber is joined end-to-end to said
6 another optical fiber through a refractive index matching agent
7 that has a refractive index at a minimum temperature in practical
8 use lower than that of said cladding.

1 **23.** The connection portion of the optical fiber according
2 to claim **21** or **22**, wherein:
3 said refractive index matching agent has an optical
4 refractive index of 1.458 or less in a 1.3 to 1.55 μm wavelength
5 band at a temperature of $-30\text{ }^{\circ}\text{C}$, and an average refractive index
6 temperature coefficient of $-8.0 \times 10^{-4} / ^{\circ}\text{C}$ or more and less than
7 0 $/^{\circ}\text{C}$ in a temperature range of $-30\text{ }^{\circ}\text{C}$ to $+70\text{ }^{\circ}\text{C}$.

1 **24.** An optical fiber splicer, comprising:
2 said connection portion of the optical fiber as defined
3 in any one of claims **21** to **23** housed in a chassis.

1 **25.** A connection portion of an optical fiber, comprising:
2 said optical fiber connected to another optical fiber,
3 said optical fiber comprising a plurality of air holes in a

4 cladding formed around a core of said optical fiber,
5 wherein said optical fiber is joined end-to-end to said another
6 optical fiber through a refractive index matching mixture that
7 has a refractive index in a temperature range in practical use
8 not more than that of said cladding, and that comprises a
9 micro-body with an average diameter or length of 100 nm or less.

1 **26.** The connection portion of the optical fiber according
2 to claim **25**, wherein:

3 said micro-body is a fine particle comprising mainly pure
4 quartz.

1 **27.** The connection portion of the optical fiber according
2 to claim **25** or **26**, wherein:

3 said refractive index matching mixture comprises a
4 refractive index matching agent with said micro-body mixed
5 therewith, and a mixture weight ratio of said refractive index
6 matching agent and said micro-body is 10:1 to 1:1.

1 **28.** An optical fiber splicer, comprising:

2 said connection portion of the optical fiber as defined
3 in any one of claims **25** to **27** housed in a chassis.